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THE EFFECT OF THE WAR ON THE CHIEF FACTORS OF POPULATION CHANGE¹

THERE have recently appeared some figures² regarding the "mouvement de la population" in France, Prussia and Bavaria which appear to deserve somewhat more careful analysis than they have received. These figures are derived from official sources and are conveniently collected in the place to which I have made reference.

There are three factors fundamentally concerned in producing changes in the absolute size of the population in a given fixed area (country, province, etc.). These are:

1. The birth-rate,
2. The death-rate,
3. The net immigration rate.

Of these factors the two first are, generally speaking, of the greatest biological interest. This is particularly true of such political units as France, Prussia and Bavaria, where in normal times net immigration makes no significant contribution to the population. Under war conditions permanent immigration to these units was *nil* and may therefore be safely neglected in the following discussion.

The relation of birth-rate and death-rate changes to population changes is a simple one and may be put this way. If in a given time unit the percentage

$$\frac{100 \text{ Deaths}}{\text{Births}}$$

has a value less than 100, it means that the births exceed the deaths, and that the population is increasing within the specified time

¹ Papers from the department of biometry and Vital statistics, School of Hygiene and Public Health, Johns Hopkins University, No. 14. This paper recently formed the basis of an evening's discussion at the writer's seminar.

² *Jour. Soc. Stat. Paris*, Soixantième Année, pp. 356-361, December, 1919.

unit. If, on the other hand, the percentage is greater than 100 it means that the deaths are more frequent than the births, and that the population is decreasing, again within the specified time unit. The ratio expressed in (i) may be conveniently designated as the vital index of a population.

were of the births for (a) the 77 non-invaded departments of France; (b) Prussia; and (c) Bavaria; and (d) England and Wales, from 1913 to 1918 by years, with the results shown in Table I. The English data were obtained from the quarterly returns (No. 284) of the registrar-general.

TABLE I
Percentage of Deaths to Births

Year	77 Non-invaded Departments of France	Prussia	Bavaria	England and Wales
1913.....	97 per cent.	—	58 per cent.	57 per cent.
1914.....	110 " "	66 per cent.	74 " "	59 " "
1915.....	169 " "	101 " "	98 " "	69 " "
1916.....	193 " "	117 " "	131 " "	65 " "
1917.....	179 " "	140 " "	127 " "	75 " "
1918.....	198 " "	132 ³ " "	146 " "	92 " "

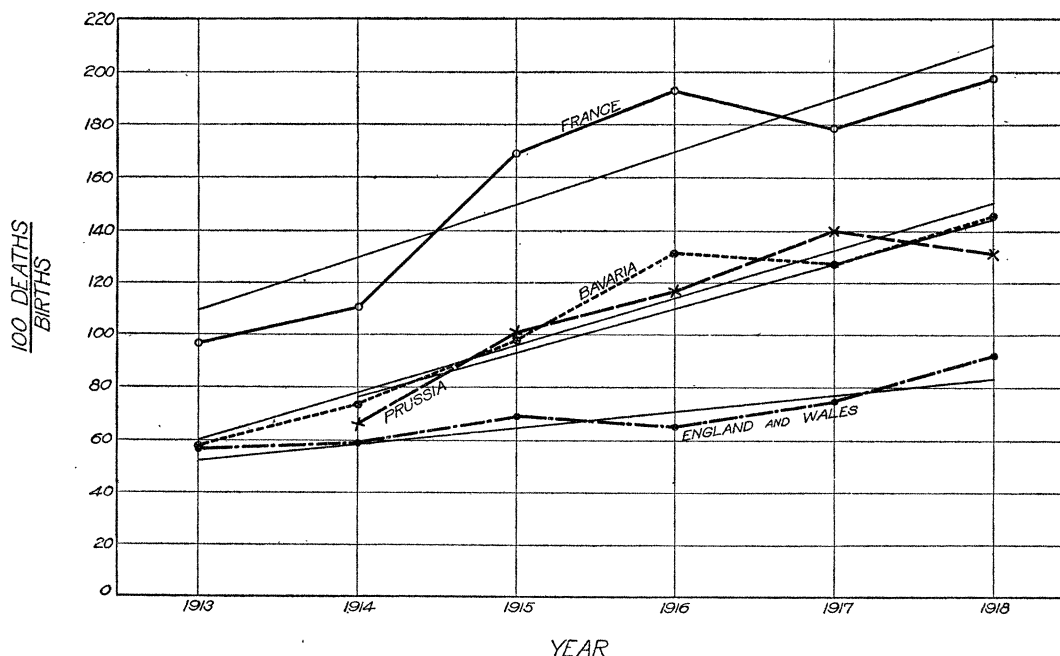


FIG. 1. Showing the change in the percentage, which deaths were of births in each of the years 1913 to 1918 in France (non-invaded departments) (—), Prussia (---), Bavaria (....) and England and Wales (— · — ·).

From the raw data of births and deaths given in the source referred to above I have calculated the percentage which the deaths

³ This percentage is based upon returns for the first three fourths of the year only.

These percentages are shown graphically in Fig. 1, together with straight lines fitted to each, by the method of least squares. The equations to the straight lines, where y denotes death/birth ratio, and x time, are:

France, $y = 84.0669 + 21.0285 x$. Origin at 1912. (ii)

Prussia, $y = 59.9 + 17.1 x$. Origin at 1913, (iii)

Bavaria, $y = 42.4668 + 18.0571 x$. Origin at 1912. (iv)

England and Wales, $y = 45.9335 + 6.2571 x$. Origin at 1912. (v)

From this diagram and the data of Table I. we note.

1. In the year prior to the beginning of the war the death-birth ratio of France was at nearly twice as high a level as in any of the other countries dealt with. This fact was of course well known. With a very low birth-rate and a death-rate of the same general order of magnitude as that prevailing in other European countries the French death-birth ratio could not be anything but extremely high.

2. In all the countries here dealt with the death-birth ratio in general rises throughout the war period. This means that the proportion of deaths to births increased as long as the war continued. In France it was slightly more than double in 1918 what it was in 1913. The same was in general true of Prussia and Bavaria. These states started from a very different base in 1913, and the relative rise was even greater.

3. In England and Wales, while the death-birth ratio increased throughout the war period, the rate of this increase was markedly slower than in any of the other countries dealt with.

4. A straight line is not a particularly good fit to the French curve, but it has been used in order to demonstrate more clearly the general trend. In 1915 and 1916 the French percentage rose markedly above the straight line. These were perhaps the years when the forces of war impinged most heavily upon the French.

5. It is noteworthy that despite the epidemic of influenza in 1918, unprecedented in its severity so far as this disease is concerned, none of the curves shows any sharp or marked rise in that year. The curve for England and Wales comes nearest to showing an effect of

the epidemic, but even then the rise in 1918 is not so marked as one might have expected.

6. The straight lines for France, Prussia and Bavaria are nearly parallel, or in other words have slopes of about the same order of magnitude (cf., the values of b which determine the slope in the straight line equations). The slope of the line for England and Wales is very different from that of the other three.

These facts raise many interesting points for discussion. The people of Prussia and Bavaria suffered progressive deprivations in respect of food and other comforts of life throughout the war. The sufferings of the French people in these respects were undoubtedly less severe than those of the Germans. All, however, lived for several years on an inadequate diet. This fact alone unquestionably contributed to an ever-increasing death-rate, particularly at the two ends of the life cycle. This same dietary factor undoubtedly also played a considerable part in producing the steady fall in the birth-rate. Here, however, the psychological factor also had a large rôle, and this introduces a point of great interest. Psychologically, the civilian French population and the civilian German population were on a different footing. In the one case, until well into 1918, the attitude was that of the potential conqueror, fighting as an invader in the other's territory. In the other case a war of defense against invasion and further destruction of the home land was being fought. Yet the net effect on the vital indices of the population was, as is shown by the essential parallelism of the straight lines, substantially the same in the one case as in the other. In any other game than war the psychological attitude of offender produces far different results from that of defender. Here the essential and outstanding fact is that the net biological outcome of the complex interplay of forces resulting from war was almost identically the same in France and Germany.

Another interesting point is that while France started in 1913 with a death-birth ratio 40 per cent higher than that of the German states—she having at that time an

approximate equality of births and deaths—nevertheless the biological changes induced by the war, as expressed in this ratio, were the same for the one as for the others. We are evidently dealing here with deep-seated and fundamental phenomena of racial biology. The biological reactions of French and Germans in respect of a most fundamental phenomenon, the death-birth ratio, were essentially the same, though they started from such different pre-war bases.

The case of England is obviously entirely different. Starting from about the same base as the German states England's biological reaction to war was much less pronounced. There are many explanations, such as better food conditions, different race psychology from any of the other belligerents, etc., which might be brought forward. There appears at the moment no way of accurately evaluating any of these possible explanations. We must perforce rest with the setting forth of the facts. It is worth noting, however, that though England's vital index changed less in degree than that of the other countries, its movement was the same in kind.

There are two other points which one would like to have information upon. The first is: What will be the course of these death-birth ratio curves in the years following 1918? Will they come back to the pre-war level, and if so, how soon? For England and Wales alone is it now possible to get an indication on this point. For the year 1919 the relation $\frac{100 \text{ Deaths}}{\text{Births}}$ had the value 73 per cent. This represents a marked drop, though it does not bring the curve back to the pre-war level. The appearance of official statistics which will make possible the further plotting of the curves of Fig. 1 will be awaited with great interest. In the second place, one would like to know what the appearance of the curve for the United States would be. Unfortunately, we have for the Registration Area of births data only for the years 1915, 1916, and 1917 now available. So few years appear inadequate to set against the longer series for the other countries.

RAYMOND PEARL

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COLORED PHOTOGRAPHS OF PLANT DISEASE SPECIMENS

In the preparation of a handbook of the diseases of vegetables by the U. S. Bureau of Plant Industry for the Food Products Inspection Service of the U. S. Bureau of Markets, it has been found practicable to make colored illustrations by the aid of a firm of commercial photographers.¹

The specimens of diseased vegetables were collected by the writers to a large extent in the Chicago markets and freight yards. In addition numerous field excursions were made into the region surrounding Chicago for the purpose of securing specimens. To date, over two hundred illustrations have been completed, a number of which were exhibited at the Baltimore and St. Louis meetings and aroused a very general and real interest on the part of the botanists. So many questions were asked concerning the process by which the illustrations were prepared that the writers are using this means of making the answers as generally known as possible.

A vertical camera was used and the specimens were arranged on a ground-glass background which eliminates shadows. Occasionally a black velvet background was used, and leaves usually were laid on wet blotting paper to prevent curling. In making the exposures, artificial light was seldom used. Most of the subjects have been reproduced in natural size on 8 by 10 inch negatives. The camera was equipped with Cooke Process Lenses, Series 5, of 16 or 18 inches focal length, or with a Goerz Dogmar lens of 12 inches focal length. Color filters, usually the K2 yellow or the green, and occasionally the red, were used in about 75 per cent. of the exposures. About two-thirds of the exposures were made on Seed's Panchromatic plates and the remainder on Polychrome or Standard Orthonon plates. The legends are etched in the gelatin of the negative. The majority of the subjects have been photographed in duplicate to insure against loss of the record by breakage.

Prints are made either on Defender or Kresko printing-out paper or on Defender or

¹ Webster Bros., Chicago, Illinois.